ROHDE & SCHWARZ

DOCUMENTATION

MODULATOR
MODEL 1020X

JANUARY 1989
Manual No. MNL-35002-A-001

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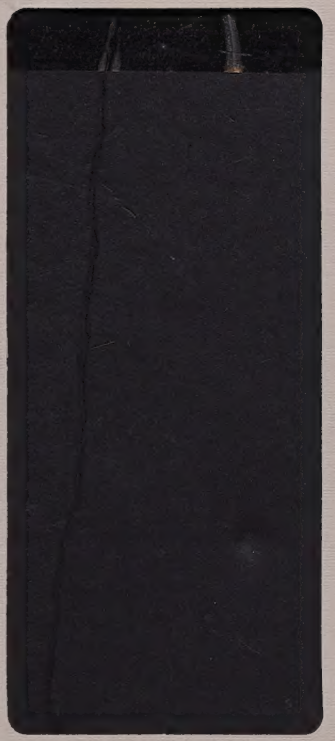

INSTRUCTION MANUAL

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INSTRUMENTATION

Warranty

ROHDE&SCHWARZ

We warranty each new instrument to be free of defects in materials and workmanship.

We will service, repair and adjust as required any instrument which proves defective within one year after date of delivery and which is returned to our factory (or other authorized depot) for that purpose.

For warranty information or other assistance, please contact our Customer Service Department in Lanham, Maryland, or an authorized regional service depot.

No other warranty is expressed or implied. No liability is assumed for consequential damages.

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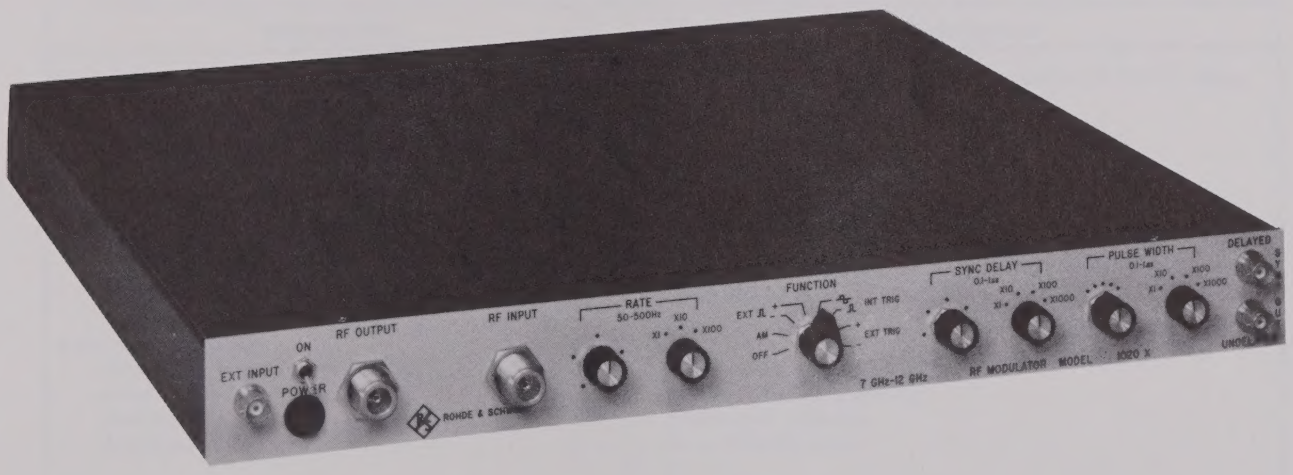


Figure 1-1. Model 1020X Modulator

SECTION I
INTRODUCTION

1-1. SCOPE OF MANUAL

1-2. This manual contains the instructions for the use and maintenance of Model 1020X Modulator (figure 1-1), manufactured by Rohde & Schwarz, Lanham, Maryland. The manual includes a general description of the equipment, operating instructions, theory of operation, maintenance data, and a parts list.

1-3. PURPOSE AND USE OF THE EQUIPMENT

1-4. Model 1020X Modulator is used for the modulation of microwave signals in the range of 7.0 to 12.0 GHz. It is used in the testing of microwave radars, beacons, and communication systems.

1-5. GENERAL DESCRIPTION

1-6. The Rohde and Schwarz, Inc. Model 1020X Modulator is a function generator which provides adjustable well-defined precise pulses and square waves. The repetition rates, for all output waveforms, are variable from 0.1 Hz to 50,000 Hz. Pulse outputs are from 0.1 to 100 microseconds. The Model 1020X Modulator can be synchronized internally or externally by positive pulses, negative pulses, or sinewaves. Sharp TTL sync pulses are also generated. Sync outputs are undelayed and delayed from 0.1 to 100 microseconds. The compact Model 1020X Modulator is provided in a 1¾ inch high modular cabinet which permits convenient rack mounting or stacking with other modular units. When the top cover is removed, all parts are accessible for ease of servicing.

1-7. ACCESSORIES SUPPLIED

1-8. Table 1-1 lists the accessories supplied with the Model 1020X Modulator.

TABLE 1-1. ACCESSORIES SUPPLIED

Name	Rhode & Schwarz Part No.
Power Cable	B160833
Instruction Manual	

1-9. EQUIPMENT SPECIFICATIONS

1-10. Table 1-2 lists the specifications for Model 1020X .

TABLE 1-2. EQUIPMENT SPECIFICATIONS

Characteristic	Specification
Modulation	Pulse, square wave and audio modulation of the RF input.
Internal Modulation:	
a. Square Wave Frequency	50 to 50,000 Hz, continuously adjustable.
b. Pulse:	
Repetition Rate	50 to 50,000 pps, continuously adjustable.
Pulse Width	0.1 to 100 microseconds, continuously adjustable.
Synchronization	Internal or external.
On/Off Ratio	>80 dBc.
External Modulation:	
Repetition Rate	Single pulse to 500 kHz.
Pulse Width	0.1 to 1.0 μs at 500 kHz.
Polarity	Positive or negative.
Amplitude	5 to 20 volts peak.
Synchronization:	
a. Internally Generated Outputs:	
Type	Delayed and undelayed (separate outputs).
Repetition Rate	50 to 50,000 pps.
Polarity	Positive.
Amplitude	2 volts peak minimum into 1K ohm load.
Delay	0.1 to 100 microseconds, continuously adjustable.

TABLE 1-2. EQUIPMENT SPECIFICATIONS (Cont'd)

Characteristic	Specification
b. External Sinewave:	
Input Frequency	50 to 50,000 Hz.
Amplitude	5 to 20 volts rms.
c. External Pulse:	
Input Repetition Rate	Single pulse to 50,000 pps.
Amplitude	5 to 20 volts peak.
Polarity	Positive or negative.
Pulse Width	0.1 to 1 microseconds.
CW:	
Insertion Loss	⩽5dB.
Input/Output SWR for Minimum Insertion Loss	2.1:1 max
Maximum Input Power	+20dBm
Power Requirements	115 or 230 volts ±10%, 50 to 400 Hz single phase, 15 watts.
Dimensions	1-3/4" H x 16-3/4" W x 16-3/8" D.
Weight	12 pounds.

SECTION II

OPERATION

2-1. GENERAL

2-2. Model 1020X is shipped complete and ready to operate, no special or permanent installation procedures are required. The instrument should be unpacked upon receipt, observing the usual precautions customary when unpacking an electronic instrument.

2-3. INSTALLATION

2-4. After unpacking the instrument, plan its installation. The Model 1020X is supplied mounted in a cabinet for either bench or cart use or may be rack mounted as shown in Figure 2-1. The instrument requires 115 or 230 volts, single phase 50 to 400 Hz ac power.

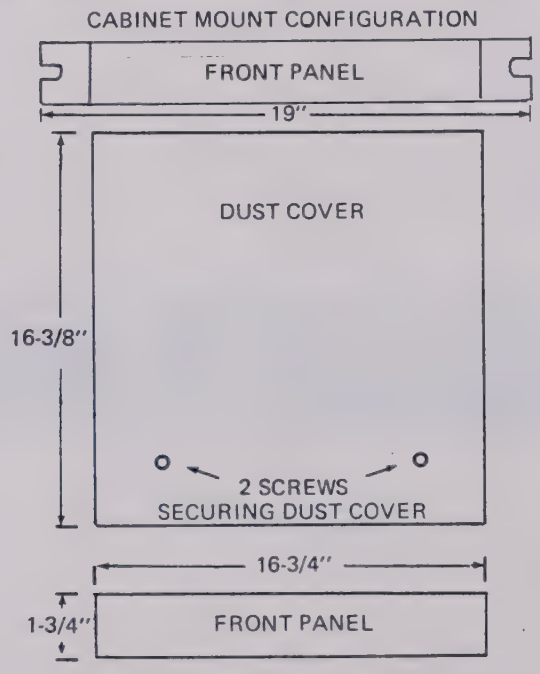


Figure 2-1. Model 1020X Modulator Installation Outline Drawing

NOTE

Model 1020X is shipped ready for 115 volt operation. If the instrument is to be operated from a 230 volt source, set the 115/230 SELECTOR switch, located on the rear panel, to the 230 volt position. The location of the switch is shown in Figure 2-2.

2-5. Connect the power cable of the instrument between the INPUT AC connector and an ac power source receptacle. If the ac power source receptacle is not a grounding type, an adapter will be required.

2-6. OPERATING PROCEDURES

2-7. The operating procedures for the Model 1020X are described in paragraphs 2-8 through 2-13.

2-8. OPERATING CONTROLS, INDICATORS, AND CONNECTORS. The operating controls, indicators, and connectors of the instrument are listed in Table 2-1 and shown in Figure 2-2.

2-9. CONNECTIONS AND PRELIMINARY OPERATIONS. To operate the Model 1020X proceed as follows:

a. Connect the instrument to a signal source or generator and device under test as shown in Figure 2-3.

b. Set the POWER switch to its on position and allow the instruments to warm up for fifteen minutes.

2-10. INTERNALLY SYNCRONIZED SQUAREWAVE OPERATION. To obtain a squarewave modulated output, proceed as follows:

a. Couple the DELAYED SYNC OUT connector and/or UNDELAYED SYNC OUT connector, as required, to the instrument being tested or to monitoring equipment.

b. Connect RF INPUT and RF OUTPUT to the generator and unit being tested.

c. Set FUNCTION switch to ⊓⊓ INT position.

d. Adjust RATE control and X1-X10-X100 multiplier switch to obtain the desired repetition rate.

e. DUTY CYCLE – DELAY LIMITATIONS. Figure 2-4 includes the pulse width to 1000 μsec. The regions for stable operation are below the curves. For example, at 2.0 μsec width and pulse repetition rate of 1000 Hz, the maximum delay would be 800 μsec. The graph in Figure 2-4 is based upon the following equation:

$$\text{DELAY} = \frac{(0.6)10^6}{\text{PRF}} - \text{PULSE WIDTH} \qquad (1)$$

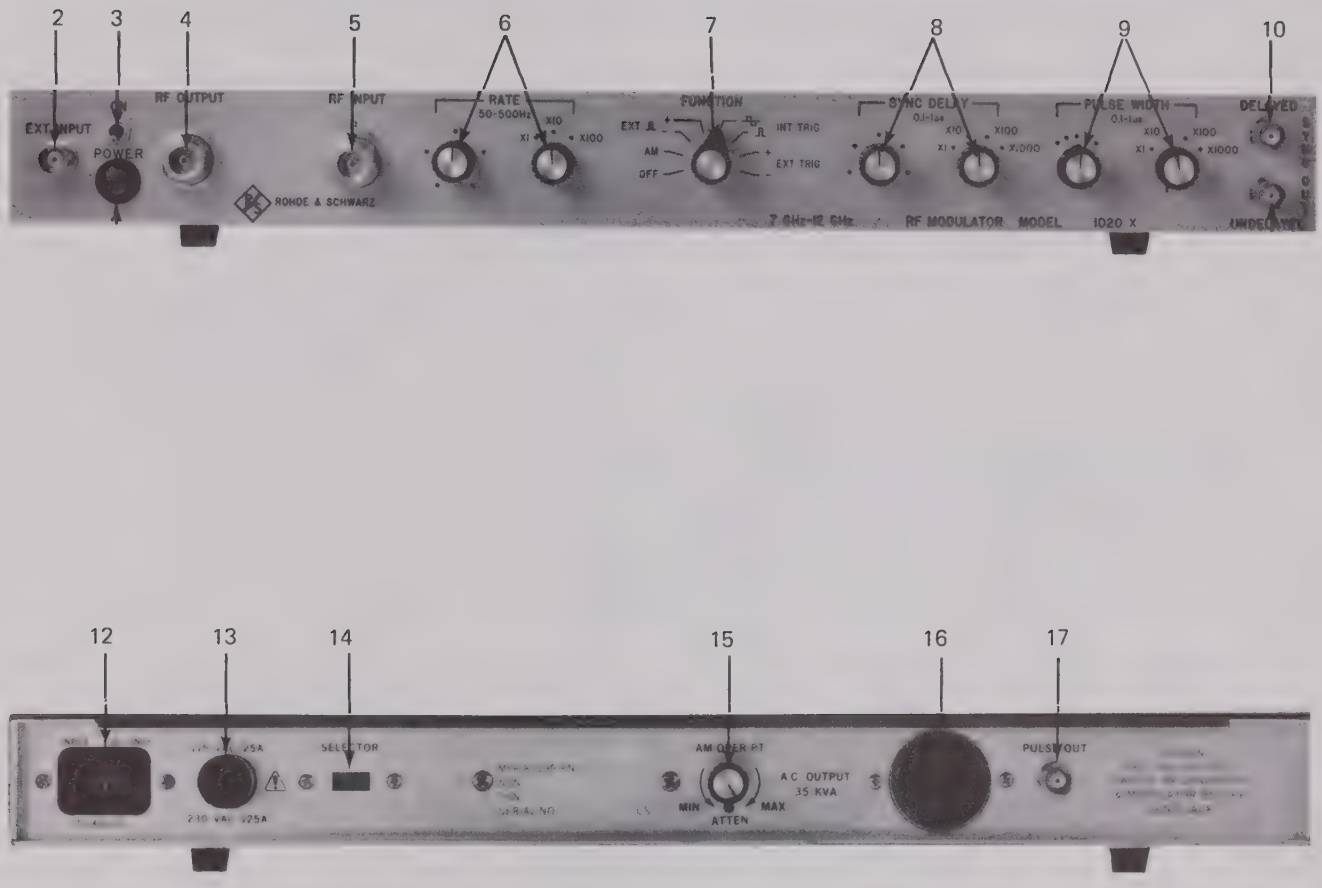


Figure 2-2. Model 1020X Operating Controls, Indicators and Connectors

TABLE 2-1. OPERATING CONTROLS, INDICATORS, AND CONNECTORS

Figure 2-2 Index No.	Control, Indicator, or Connector	Function
1	ON Indicator Lamp	Lights when power is applied to the unit.
2	EXT INPUT connector	Connects the Model 1020X to either externally synchronized, externally pulse modulated signals, or external AM.
3	POWER switch	Controls application of ac power.
4	RF OUTPUT connector	Couples RF modulated output to device being tested.
5	RF INPUT connector	Couples unmodulated source to the modulator.
6	RATE control and X1-X10-X100 multiplier switch	Adjusts modulation repetition rate from 50 to 50,000 pps.
7	FUNCTION switch	Controls all types of modulations. a. Set to OFF to disable the modulator. b. Set to AM for an RF signal from an external source. c. Set to EXT ⎍ (–) when a negative synchronizing pulse is applied. d. Set to EXT ⎍ (+) when a positive synchronizing pulse is applied. e. Set to ⊓⊓ INT TRIG for internal squarewave modulation. f. Set to ⎍ INT TRIG for internal pulse modulation. g. Set to + EXT TRIG when a positive synchronizing pulse is externally applied. h. Set to –EXT TRIG when a negative synchronizing pulse is externally applied.
8	SYNC DELAY control and X1-X10-X100-X1000 multiplier switch	Adjusts delay between both rf output pulse and delayed sync output pulse from 0.1 to 1000 microseconds.
9	PULSE WIDTH control and X1-X10-X100-X1000 multiplier switch	Adjusts width of rf output pulse from 0.1 to 1000 μsec X1 0.1 to 1 μsec X100 10 to 100 μsec X10 1.0 to 10 μsec X1000 100 to 500 μsec. Pulse width range overlap on all positions.
10	DELAYED SYNC OUT connector	Provides positive video trigger pulse in time coincidence with leading edge of rf output pulse.
11	UNDELAYED SYNC OUT connector	Provides positive video trigger pulse which leads both rf output pulse and delayed sync output pulse in time.
12	AC INPUT connector*	Connection for external ac power source.
13	115VAC/230VAC Fuse*	Circuit protection.
14	115/230 SELECTOR switch*	Selects input power voltage level.
15	AM OPER PT control*	Adjusts AM point of operation.
16	AC OUTPUT connector*	Connection for ac power cable between Model 1020X and other equipment.
17	PULSE OUT connector*	Pulse signal output.

* Located on rear panel.

Where the delay is in μsec, width which is in μsec, and PRF is in pulses/sec.

f. The STABILITY SAFETY formula contains a 70% safety factor. Any combination of Delay, Width, and PRF that satisfy this formula will result in stable pulsing. Stable operation may be maintained in most control combinations up to the instrument's pulsing capability, without the safety factor. This can be derived by dropping the 0.7 multiplier in Equation 1, resulting in the equation:

$$\text{DELAY} = \frac{10^6}{\text{PRF}} - \text{PULSE WIDTH} \qquad (2)$$

If the controls are set beyond limits of the curve, Figure 2-4 (Operations Settings above the curves), use of an external scope is recommended to be sure of stable operation. There cannnot be stable pulsing beyond the limits of Equation 2.

NOTE

Do not extend the duty cycle. Refer to Figure 2-4.

2-11. INTERNALLY SYNCHRONIZED PULSE OPERATION. To obtain pulse modulated output, proceed as follows:

a. Set the FUNCTION switch to INT ⎍ .

b. Adjust RATE control and X1-X10-X100 multiplier switch to obtain desired pulse repetition rate.

c. Adjust PULSE WIDTH control to obtain desired pulse width.

d. Adjust SYNC DELAY control and X1-X10-X100 multiplier switch to obtain desired delay between the undelayed sync output pulse and the leading edge of the pulse modulated rf output signal.

NOTE

Do not exceed duty cycle. Refer to Figure 2-4.

2-12. EXTERNALLY SYNCHRONIZED PULSE OPERATION. Model 1020X may be synchronized by externally applied positive or negative pulses or sine waves with an amplitude of 5 to 20 volts peak for the pulses or 5 to 20 volts rms for the sine waves. The same operational procedure is followed as for the internally synchronized pulse operation (para. 2-11) except that the FUNCTION switch is set in either the +EXT TRIG or –EXT TRIG position, as determined by the nature of the externally supplied synchronizing signal.

NOTE

Do not exceed duty cycle. Refer to Figure 2-4.

2-13. EXTERNAL PULSE OPERATION. To obtain a pulse modulated output programmed by an external pulse source, proceed as follows:

a. Set FUNCTION switch to either EXT ⎍ + or EXT ⎍ – position.

b. The pulse width and repetition rate are both a function of the settings on the external pulse source.

NOTE

Do not exceed duty cycle. Refer to Figure 2-4.

2-14. PACKAGING INSTRUCTIONS

2-15. PACKAGING FOR SHORT-TERM STORAGE. If the Model 1020X is to be stored for a relatively short period, cover it with a suitable protective covering such as a sheet of plastic or paper. Put the accessories and instruction manual in a carton or bag and fasten to the unit to prevent loss. Store the Model 1020X in a clean dry area where it will not be subject to extreme temperatures.

2-16. PACKAGING FOR LONG-TERM STORAGE OR SHIPMENT. If the Model 1020X is to be stored for a long period of time, or shipped, proceed as follows:

a. If the original wrappings and carton have been saved, use them to package the equipment as shown in Figure 2-5.

b. If new packing materials are to be used, assemble the necessary wrappings and carton.

c. Wrap the equipment in a moisture- and vapor-proof barrier such as plastic or waterproof paper.

d. Wrap the accessories and instruction manual in a moisture- and vapor proof barrier.

e. Place the package in a suitable carton. Fill all empty spaces in the carton with suitable packing to prevent shifting of the packages within the carton.

f. Seal and mark the carton.

g. If the storage or shipping conditions make it necessary, enclose the carton in an outer carton or wooden box.

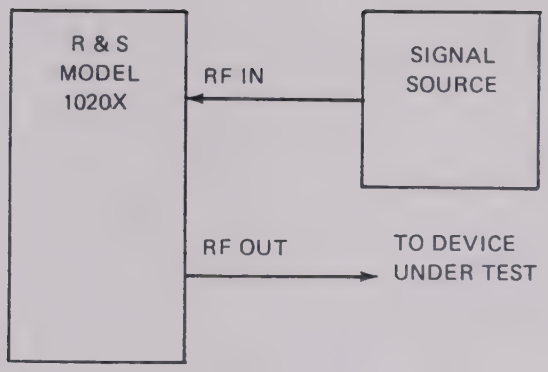


Figure 2-3. Operational Setup for Model 1020X

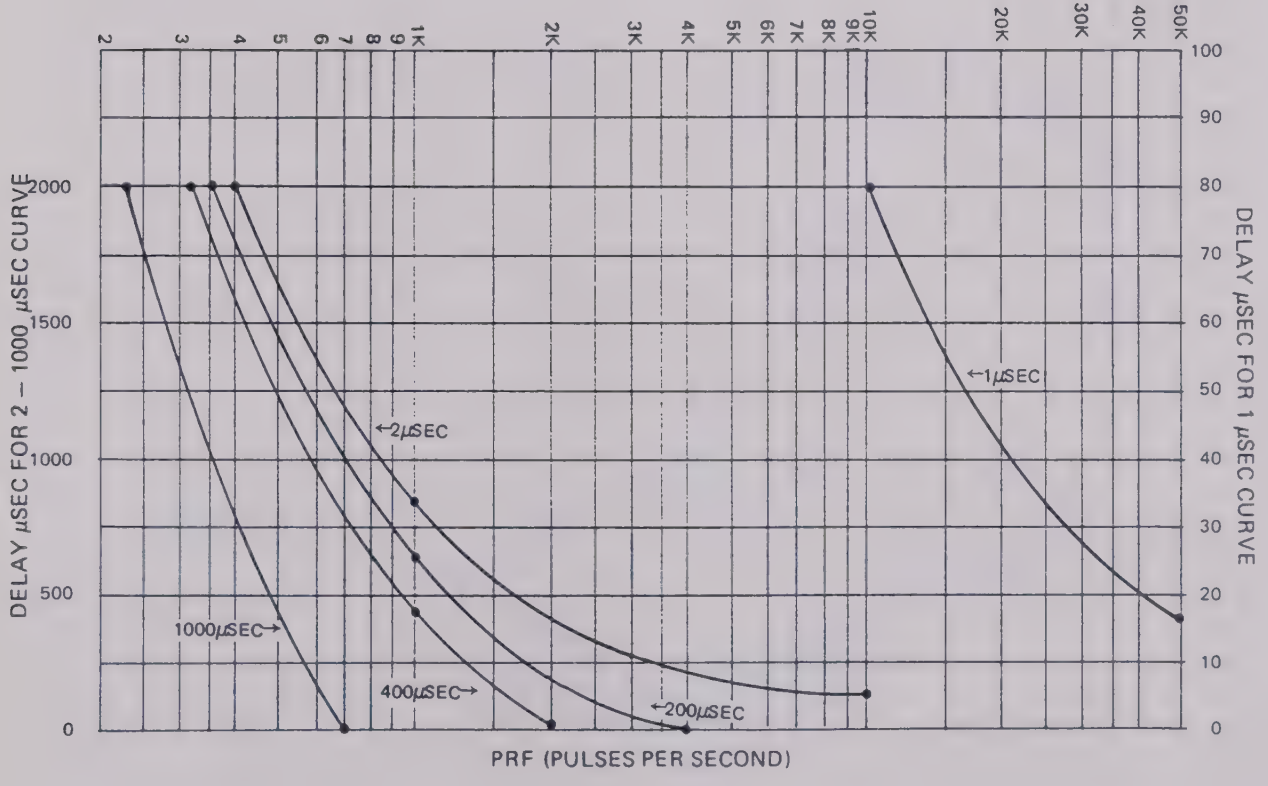


Figure 2-4. Maximum Pulse Delay Versus Repetition Rate

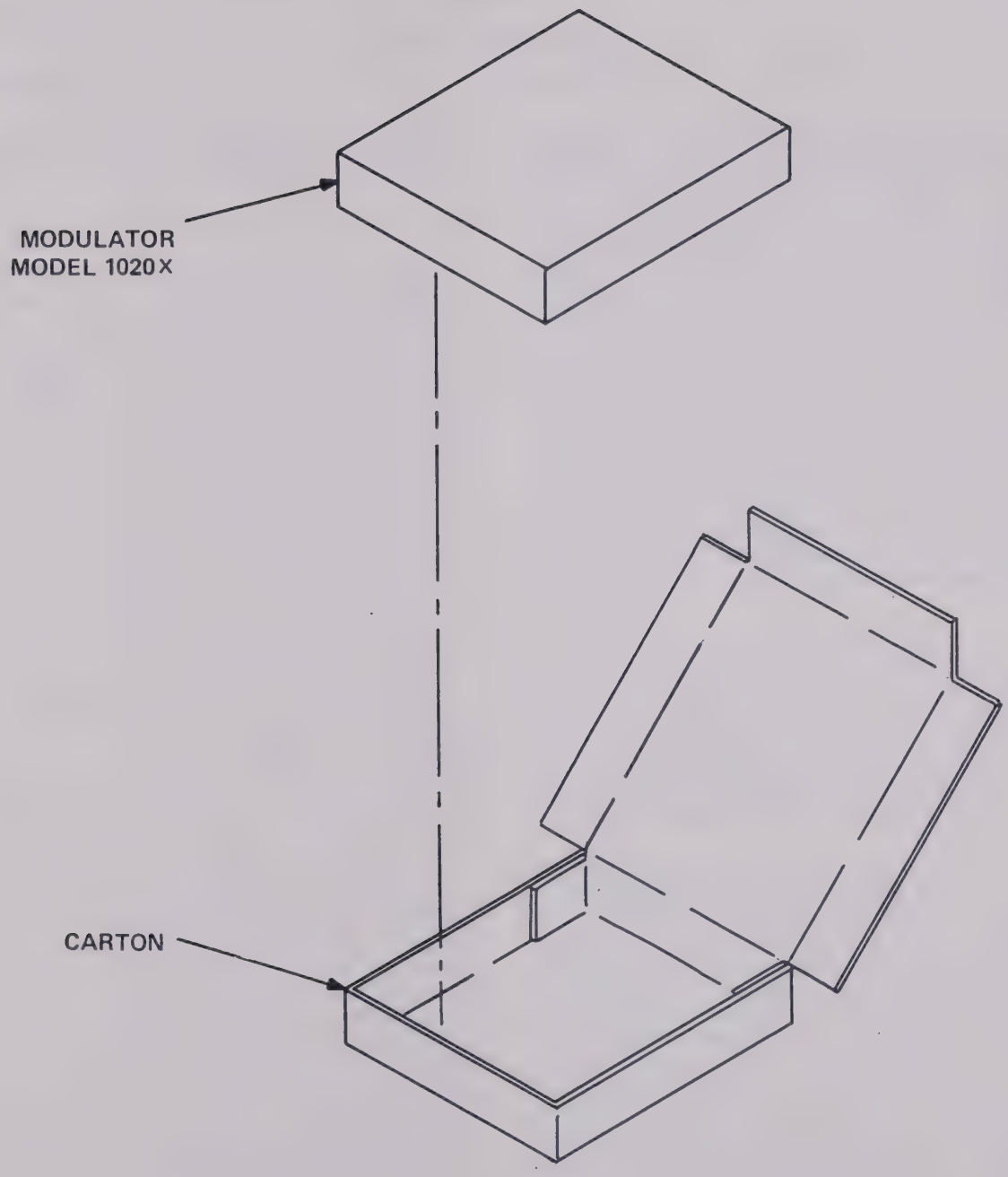


Figure 2-5. Model 1020X Packaging Diagram

SECTION III

THEORY OF OPERATION

3-1. GENERAL

3-2. The Model 1020X is a precision pulse, square-wave, sawtooth generator designed for use with available commercial signal generators and sources.

3-3. BLOCK DIAGRAM ANALYSIS. (Figure 3-1)

3-4. Model 1020X is comprised of a group of circuits which generate, shape, delay, and modulate the microwave signal as required. The Rate Generator is a free-running unijunction oscillator which serves to generate the basic pulse repetition rates. When FUNCTION switch (S2) is set at its INT ⎍ position, the pulse output of the Rate Generator (A1Q1 and A1Q23) divided by the means of the ÷2 Flip-Flop (A2U3) is applied to the Schmitt Trigger (A1Q8, A1A9, and A1Q10) The Schmitt Trigger output, a squarewave, is applied to the Pulse Generator where the output pulses of desired width and delay are generated. The Pulse Generator consists of of two monostable multivibrators A1U1 and A1U2. A1U1 develops the desired pulse delay of 0.1 to 1000 μsec in conjunction with front panel controls; SYNC DELAY (R41), and X1-X10-X100-X1000 multiplier switch (S4). A1U1 has two outputs; one output is applied to the Undelayed Sync Amp for amplitude and impedance conditioning prior to appearing at the UNDELAYED SYNC OUT output connector (J2). The other output is applied to A1U2 where the desired output of 0.1 to 1000 μsec is developed in conjunction with PULSE WIDTH control (R76) and X1-X10-X100-X1000 switch (S7). A1U2 also has two outputs; one output is applied to the Delayed Sync Amp for amplitude and impedance conditioning prior to appearing at the DELAYED SYNC OUT connector (J3). The other output is routed through the FUNCTION switch to the Pulse Amplifier prior to modulating the RF signal. With the FUNCTION switch set at INT TRIGGER ⎍⎍ position, the squarewave output of the Schmitt Trigger is applied to the Pre-Output Amplifier (A1Q17) rather than the output of A1U1 and the resultant output modulates the RF signal with a squarewave. With the FUNCTION switch set at its EXT ⎍ /+,– position, an external signal connected to the EXT INPUT connector (J1) is processed through the EXT Signal Amplifier (A1Q6, A1Q7) to the Schmitt Trigger input. The output signals appearing at the UNDELAYED SYNC OUT and DELAYED SYNC OUT connectors are directly related to the external input signal applied to EXT INPUT connector (J1).

3-5. DETAILED CIRCUIT ANALYSIS (Figure 5-1)

3-6. Paragraphs 3-7 through 3-16 contain a detailed analysis of the various circuits of Model 1020X

3-7. RATE GENERATOR A1Q1, A1Q23. The rate generator is a free-running unijunction oscillator. With the FUNCTION switch in its INT TRIG ⎍ / ⎍⎍ positions and the RATE X1-X10-X100 switch set to X100, the basic repetition rate is determined by RG components A1R4, A1R5, A1R6, and A1C3 and will be in the range of 2000 to 50,000 pps. The actual rate will depend upon the setting of front panel RATE control R5. When the Rate X-X10-X100 switch is in the X1 position the repetition rate will be in the range of 50 to 500 pps due to the addition of A1C1 which increases the charging time constant in the unijunction emitter circuit. A1Q23 is a feedback current source which linearizes the sweep. As the capacitive components charge in the emitter circuit, a positive going sawtooth waveform is developed. When the firing potential is reached at the emiiter, A1Q1 turns on and allows the capacitive components to discharge through A1R2 and A1L1 creating sharp pulses across A1R2 and A1L1. These pulses are fed to the ÷2 Flip/Flop (A2U3) which divides the input pulses in half to develop the output repetition rate of 50 to 50,000 pps.

3-8 ÷2 FLIP/FLOP A2U3. The ÷2 Flip/Flop accepts the positive going pulses from the Rate Generator, in the range of 100 to 100,000 pps and produces a squarewave at A2-U3-11, at the output rate of 50 to 50,000 Hz. The squarewave is routed through the FUNCTION switch to the INT position of the FUNCTION switch (S2). When the FUNCTION switch is in the INT position, the squarewave is fed to the Schmitt Trigger circuit for further processing.

3-9. SCHMITT TRIGGER A1Q8, A1Q9, A1Q10. The input of the Schmitt Trigger is determined by the position of the FUNCTION switch. When the FUNCTION switch is in its INT positions, a squarewave from the ÷2 Flip/Flop will be applied to the input. When the FUNCTION switch is in its EXT positions the output of the Ext Signal Amplifier will depend on the type of signal waveform connected to the EXT INPUT connector (J1). The Schmitt Trigger circuit composed of A1Q8 and A1Q9 is a dc coupled amplifier used to improve the rise and fall time of the input waveform. A1Q10 is an emitter follower used to provide a low output impedance for the circuit. A positive going signal will provide a positive going signal at the emitter of A1Q9. The Schmitt Trigger provides two outputs; a squarewave which is direct coupled through the FUNCTION switch, when it is in its EXT ⎍ /INT TRIG ⎍⎍ position, to the ⎍⎍ Output Amplifier. The other output is differentiated by A1C16 and A1R38 and routed to the Pulse Generator for pulse shaping and delay.

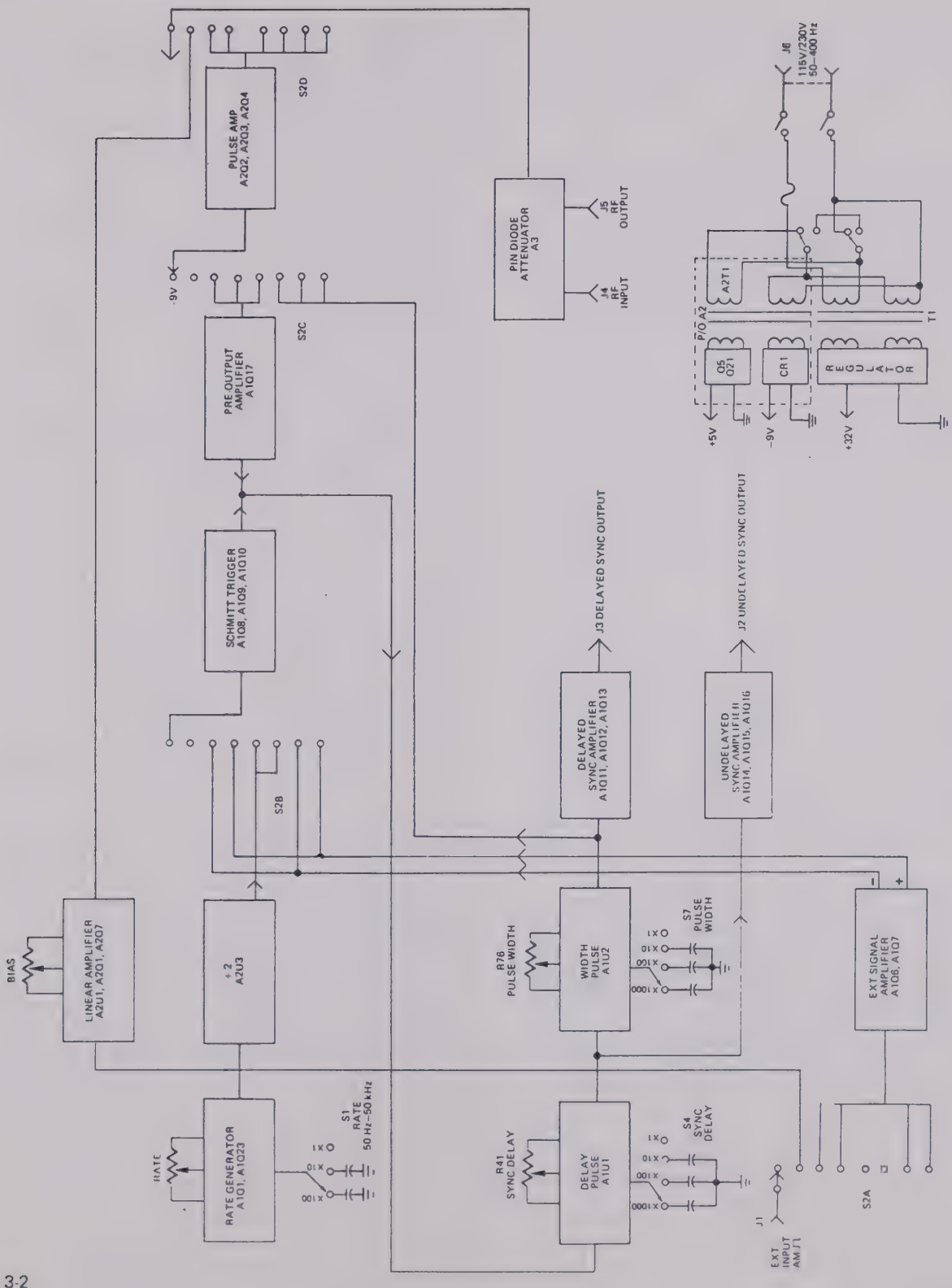


Figure 3-1. Model 1020X Modulator, Block Diagram

3-10. PULSE GENERATOR A1U1, A1U2. The Pulse Generator consists of two integrated monostable multivibrators A1U1 and A1U2. As the integrated circuits are connected, they require a positive going signal to activate the signal. The positive going output of the Schmitt Trigger used to initiate pulse generation is differentiated by A1C16 and A1R38 and applied to the input of A1U1. The pulse output of A1U1 is a negative going waveform, whose duration is determined by A1C17, A1C18, A1C38 or A1C39, A1C40, and the front panel SYNC DELAY controls R41 and S4. The output pulse of A1U1 is differentiated by A1C19 and A1R42, the leading or negative going edge is routed to the Undelayed Sync Amplifier while the positive going edge, which represents the fall of the pulse developed by A1U1, is connected to the input of A1U2. The positive input to A1U2 initiates pulse generation by A1U2 which is a positive going waveform whose duration is the output pulse width determined by A1C36, A1C37, A1C48 or A1C49/A1C50, and PULSE WIDTH controls R76 and S7. The duration of the pulse generated by A1U1 therefore represents the delay time between the undelayed sync pulse and the output and delayed sync pulse. The leading edge of the output pulse and the delayed sync pulse are coincident.

3-11. UNDELAYED SYNC AMPLIFIER A1Q14, A1Q15, A1Q16. The undelayed sync amplifier input transistor A1Q14, a pnp type, is quiescently cut off. The negative going pulse from the differentiating network of A1C19 and A1R42 causes A1Q14 to conduct allowing the collector to go positive causing A1Q15 to conduct, dropping its collector to ground potential. When the collector of A1Q15 assumes its low potential state, A1Q16 conducts allowing its collector to go positive and somewhat less than +5 volts. The collector of A1Q16 is connected to the UNDELAYED SYNC OUT connector (J3) through A1R73.

3-12. DELAYED SYNC AMPLIFIER A1Q11, A1Q12, A1Q13. The delayed sync amplifier input transistor A1Q11, an npn type, is quiescently cut off. The positive going pulse from the differentiating network of A1C25 ann A1-R57 causes A1Q11 to conduct and develop a positive going signal across A1R58. The positive potential applied to A1Q12, which is also quiescently cut off, causes A1Q12 to conduct dropping its collector to ground potential. When the collector of A1Q12 assumes its low potential state, A1Q13 conducts allowing its collector to go positive and somewhat less than +5 volts. The collector of A1Q13 is connected to the DELAYED SYNC OUTPUT connector (J2) through A1R62.

3-13. ⎍⊓ PRE-OUTPUT AMPLIFIER A1Q17. The ⎍⊓ pre-out amplifier input transistor A1Q17 is normally "on" and is caused to cut off by applying negative going waveforms to its base.

3-14. EXT INPUT AMPLIFIER A1Q6, A1Q7, The external input signal applied to the ext input amplifier is applied to the EXT INPUT connector (J1). The input signal is coupled through the network A1R22 and A1C12 and applied to the gate of A1Q6. The signal appearing at the gate of A1Q16 may be positive or negative and is held to a potential of approximately 2.4 volts due to the clamping action of diodes A1CR5 through A1CR12. The drain of A1Q6 is coupled to an amplifier A1Q7 which provides two signals of opposing phase to FUNCTION switch (S2).

3-15 A1 POWER SUPPLY. The power supply develops one regulated dc voltage of +32 volts. The input power is routed through cable (W1), power switch (S6), fuse (F1), 115/230 SELECTOR switch (S5) to transformer (T1). T1 steps the input voltage down to the required level which is then full-wave rectified by bridge A1B1. The output of A1B1 is applied to the collector of Q20, the +32-volt output transistor. The base of Q20 is held to +33 volts by diode A1CR2. The +32 volt output appears at the emitter of Q20 and is distributed though the modulator circuitry.

3-16. A2 POWER SUPPLY. The Pulse AM Driver Board Assembly A2 contains a power supply that generates +5 volts, +9 volts, and −9 volts. The primary windings of transformer A2T1 are connected in parallel with transformer T1. One of the secondary windings feeds a bridge rectifier to provide the 8 volts dc output to be regulated down to 5 volts. Transistor Q21 is the series regulator element. A2R19 controls the output voltage through A2Q5. The other secondary winding circuitry doubles the voltage and is rectified by A2CR6 and A2CR12. Zener diode A2CR1 maintains the −9 volt output voltage.

3-17. PULSE AM DRIVER BOARD ASSEMBLY A2. The pulse AM Driver Board Assembly A2 includes the +5-volt and −9-volt power supplies described in paragraph 3-16 and in addition transistor A2Q6 produces a regulated +9 volts from +32volts. Pulse driver amplifier A2Q2, A2Q3, and A2Q4 forms the pulse waveform necessary to drive the pin switches. A2U3 divides the input pulses to produce a squarewave and half the frequency. A2Q1, A2Q7, and A2U1 integrate a linear amplifier to drive the pin modulator with a low distortion signal from the proper AM.

SECTION IV

MAINTENANCE

4-1. GENERAL

4-2. This section contains maintenance and alignment procedures for Model 1020X Modulator. Included are a list of test equipment required, minimum performance standards that are used to ascertain equipment capability, and troubleshooting procedures.

4-3. TEST EQUIPMENT REQUIRED

4-4. The test equipment required for maintenance and adjustment of Model 1020X are listed in Table 4-1.

TABLE 4-1. TEST EQUIPMENT REQUIRED

Name	Manufacturer Part Number	Use
Digital Multimeter	Fluke 8000A	Checking voltages and resistances
Oscilloscope	H-P 1725A	Checking waveshapes
Audio Generator	R&S SPN	Checking external sync
Freq. Counter	EIP 545	Adjusting rate generator
RF Generator	R&S 308	Evaluate signal output
Variac		Adjusting line voltage

4-5. MINIMUM PERFORMANCE STANDARDS

4-6. The purpose of the minimum performance standards listed in Table 4-2 is to determine if Model 1020X is operating in compliance with the specifications listed in Section I.

4-7. TROUBLESHOOTING

4-8. Should Model 1020X fail to meet any of the minimum performance standards given in Table 4-2, the trouble may be determined and corrected through the use of Table 4-2 by following the instructions given in the "If Indication is Abnormal" column. The Model 1020X Block Diagram and Schematic, Figures 3-1 and 5-1 respectively, should be referred to when troubleshooting.

4-9. DISASSEMBLY AND REASSEMBLY INSTRUCTIONS (See Figures 6-2, 6-3, and 6-4)

4-10 The top which forms the dust cover for Model 1020X , is removed by unscrewing the two screws which hold the top cover in place, thereby making adjustments and components accessible.

4-11. ADJUSTMENT PROCEDURES

4-12. The adjustment procedures for Model 1020X are given in paragraph 4-13.

4-13. SETTING HIGH REPETITION RATE ADJ. CONTROL A1R6. To adjust the repetition rate of the rate generator at the high repetition rate, proceed as follows:

a. Set FUNCTION switch to INT

b. Set the RATE control fully clockwise.

c. Set the RATE X1-X10-X100 multiplier switch to X100.

d. Connect the Frequency Counter to the PULSE OUT connector (located on the rear panel).

e. Note the indication on the Frequency Counter. It should indicate a repetition rate of 50,000 pps. If it does not, proceed to step f.

f. Adjust Rate Adj Control A1R6 to obtain a Frequency Counter indication of 50,000 pps.

4-14. PREVENTIVE MAINTENANCE

4-15. PERIODIC INSPECTION. Table 4-3 contains the criteria for a visual inspection. A regular schedule for this inspection should be adhered to so that minor faults can be observed and corrected before more serious damage results.

TABLE 4-2. MINIMUM PERFORMANCE STANDARDS

Step	Purpose	Procedure	Normal Indication	If Indication is Abnormal
1	Evaluate operating power conditions.	Connect power cable (and adapter, if necessary) to power source outlet. Set POWER switch to ON.	Power indicator lights.	Check lamp DS1, 115/230 SELECTOR switch, Fuse F1, POWER switch, and Power Cable W3.
2	Evaluate internal squarewave operation.	Couple the RF INPUT to the RF Generator and the RF OUTPUT to a detector and oscilloscope (oscilloscope input 50Ω). a. Set FUNCTION switch to ⊓⊔ INT TRIG. b. Set RATE control and multiplier switch as follows and note display on the oscilloscope screen: RATE Control / Multiplier Switch 50 / X10 500 / X100	Squarewave frequency is variable from 50 to 50,000 Hz. 50 waveform/sec 500 waveform/sec	No Output a. Check power supply for +32v ±5%, +5v ±5%. b. Check FUNCTION switch S2, wafer B. c. Check ⊓⊔ Output Amplifiers A1Q7, A2Q2, A2Q3, and A2Q4. d. Check FUNCTION switch S2, wafer C. e. Check Schmitt Trigger A1Q8, A1Q9, and A1Q10. f. Check FUNCTION switch S2, wafer D. g. Check ÷2 Flip/Flop A2U3. h. Check Rate Generator A1Q1, A1Q23. Incorrect Repetition Rate: a. Check power supply for +32v ±5%. b. Check RATE control R5 and multiplier switch S1. c. Check High Repetition Rate Adjustment A1R6 as per paragraph 4-13. d. Check ÷2 Flip/Flop A2U3.

TABLE 4-2. MINIMUM PERFORMANCE STANDARDS (Cont'd)

Step	Purpose	Procedure	Normal Indication	If Indication is Abnormal
3	Evaluate internal pulse operation.	Couple PULSE OUT connector to the vertical input terminals of the oscilloscope and proceed as follows: a. Set FUNCTION switch to ⊓⊓ INT TRIG. b. Rotate SYNC DELAY μs control fully counterclockwise and set the multiplier switch to X1. c. Adjust PULSE WIDTH control, RATE control and multiplier switch as follows and note displays on the oscilloscope screen: PULSE WIDTH Control / RATE Control / Multiplier Switch 0.1 / 50 / X1 0.1 / 500 / X100 100 / 50 / X1	Pulse width variable from 0.1 to 100 μsec. Pulse repetition rate variable from 50 to 50,000 pps. 0.1 μs 50 pps 0.1 μs 50,000 pps 1000 μs 50 pps	No Output: a. Check power supply for +5v and +32v ±5%. b. Check FUNCTION switch S2, wafer B. c. Check ⊓⊓ Output Amplifier A2Q2, A2Q3, A2Q4. d. Check FUNCTION switch S2 wafers C and D. e. Check A1U1. f. Check A1U2. g. Check Schmitt Trigger A1Q8, A1Q9, A1Q10. h. Check ÷2 Flip-Flop A2U3. i. Check Rate Generator A1Q1, A1Q23. Incorrect Repetition Rate: a. Check power supply for +32V ±5%. b. Check RATE control switch R5 and multiplier switch S1. c. Check High Repetition Rate Adjustment A1R6 as per paragraph 4-13. d. Check ÷2 Flip/Flop A2U3. Incorrect Pulse Width: a. Check power supply for +5v ±5%.

TABLE 4-2. MINIMUM PERFORMANCE STANDARDS (Cont'd)

Step	Purpose	Procedure	Normal Indication	If Indication is Abnormal
3 Cont.				b. Check PULSE WIDTH control R76. c. Check A1U2.
4	Evaluate external input signal operation. (External synchronization).	Connect EXT INPUT connector to the Audio Generator and PULSE OUT connector to the vertical input terminals of the oscilloscope. Proceed as follows and note the displays on the oscilloscope screen: a. Set FUNCTION switch to EXT TRIG +. b. Adjust PULSE WIDTH control and the Audio Generator Repetition Rate control as follows and note the displays on the oscilloscope screen: PULSE WIDTH Control / Audio Generator Repetition Rate Control 0.1 / 50 10 / 50 0.1 / 500 10 / 500	Pulse width of externally synchronized output pulse from 0.1 to 100 μsec. Repetition rate is determined by that of the audio generator. NOTE: Do not exceed duty cycle. Refer to Figure 2-4. 0.1 μs 50pps 10 μs 50pps 0.1 μs 500 pps 10 μs 500 pps	No Output: a. Check power supply for +5v ±5% and +32v ±5%. b. Check FUNCTION switch S2, wafer A. c. Check ⎍⎓ Output Amplifier A2Q2, A2Q3, A2Q4. d. Check FUNCTION switch S2, wafers B, C, D. e. Check A1U2. f. Check A1U1. g. Check Schmitt Trigger A1Q8, A1Q9, A1Q10. h. Check EXT Input Amplifier A1Q6, A1Q7. Incorrect Pulse Width: a. Check power supply for +5v ±5%. b. Check PULSE WIDTH control R76. c. Check A1U2.
5	Evaluate characteristics of undelayed sync output pulse.	Couple UNDELAYED SYNC OUT connector to the vertical input terminals of the oscilloscope. Program Model 1020X for internal pulse operation. (Refer to paragraph 2-11.)	Pulse obtained is +25 volts peak (minimum) and has a rise time of 0.1 to 10 μsec.	No Output: a. Check power supply for +5v ±5% and +32v ±5%.

TABLE 4-2. MINIMUM PERFORMANCE STANDARDS (Cont'd)

Step	Purpose	Procedure	Normal Indication	If Indication is Abnormal
5 Cont.		Note oscilloscope displays for the following settings of RATE control and multiplier switch. RATE Control / Multiplier Switch 10 / X1 500 / X100	Pulse repetition rate is variable from 50 to 50,000 pps. 50 pps 500 pps	b. Check Undelayed Sync Amplifier A1Q14, A1Q15, A1Q16. c. Check A1U1. d. Check Schmitt Trigger A1Q8, A1Q9, e. Check ÷2 Flip/Flop A2U3. f. Check FUNCTION switch S2, wafers B, C, D. g. Check Rate Generator A1Q1, A1Q23. Incorrect Repetion Rate: a. Check power supply for +32v ±5%. b. Check RATE control R5 and multiplier switch S1. c. Check High Repetition Rate Adjustment A1R6 as per procedures in paragraph 4-13. d. Check ÷2 Flip/Flop A2U3.
6	Evaluate characteristics of delayed sync output pulse.	Connect DELAYED SYNC OUT connector to the vertical input terminals of the oscil- and UNDELAYED SYNC OUTPUT connector to the external trigger terminals of the oscilloscope. Program Model 1020X for internal pulse operation (Refer to paragraph 2-10). Set RATE control to 100 and multiplier switch to X1 and note oscilloscope displays for the following settings of SYNC DELAY control and multiplier switch. SYNC DELAY	Pulse obtained is ∿5v and has a rise time of 0.1 to 10 μsec. Delay variable from 0.1 to 500 μsec.	No Output: a. Check power supply for +5v ±5% and +32v ±5%. b. Check Delayed Sync Amp A1Q11, A1Q12, A1Q13. c. Check A1U2. d. Check A1U1. e. Check Schmitt Trigger A1Q8, A1Q9, A1Q10.

TABLE 4-2. MINIMUM PERFORMANCE STANDARDS (Cont'd)

Step	Purpose	Procedure	Normal Indication	If Indication is Abnormal
6 Cont.		SYNC DELAY Control: .1 → Multiplier Switch: X1 Control: 10 → Multiplier Switch: X100	0.1 μsec minimum 1000 μsec minimum	f. Check FUNCTION switch S2, wafers B, C, D. g. Check ÷2 Flip/Flop A2U3. h. Check Rate Generator A1Q1, A1Q23. Incorrect Delay: a. Check power supply for +5v ±5%. b. Check SYNC DELAY control R41 and multiplier switch S4. c. Check A1U1.
7	Evaluate external pulse operation. For pulse modulation programmed from an external pulse source.	Connect EXT INPUT connector to the RF Generator and PULSE OUT connector to the vertical input terminals of the oscilloscope. Proceed as follows and note the display on the oscilloscope screen: a. Set FUNCTION switch to either EXT ⎍ –/+.	Pulse width and repetition rate is determined by the external pulse source within the following: Pulse Width: 0.1 to 0.1 μsec. Repetition Rate: Single pulse to 500 kHz. NOTE: Do not exceed duty cycle. Refer to Figure 2-4.	Follow procedures given in Step 4, omitting procedual steps e and f.
8	Evaluate AM operation.	Connect EXT INPUT connector to the output of the RF Generator. Connect an RF source to the RF INPUT connector of Model 1020X . Connect a detector to the RF OUTPUT connector and to an oscilloscope.	Oscilloscope will show a sinewave signal. Adjust rear panel AM OPER PT control for minimum distortion.	Check AM Amplifier A2U1, A2Q2, A2Q7, and associated circuitry.

TABLE 4-2. MINIMUM PERFORMANCE STANDARDS (Cont'd)

Step	Purpose	Procedure	Normal Indication	If Indication is Abnormal
9	Evaluate Pin Modulator	Connect RF source to the RF INPUT connector. Connect a detector to the RF OUTPUT connector. Connect detector to an oscilloscope and observe pulse shape.	With a 50 kHz internal signal (FUNCTION to INT PULSE) and DELAY	If PULSE OUT is correct and the detector shows a different rise and fall time, the pin modulator is faulty.

TABLE 4-3. PERIODIC INSPECTION SCHEDULE

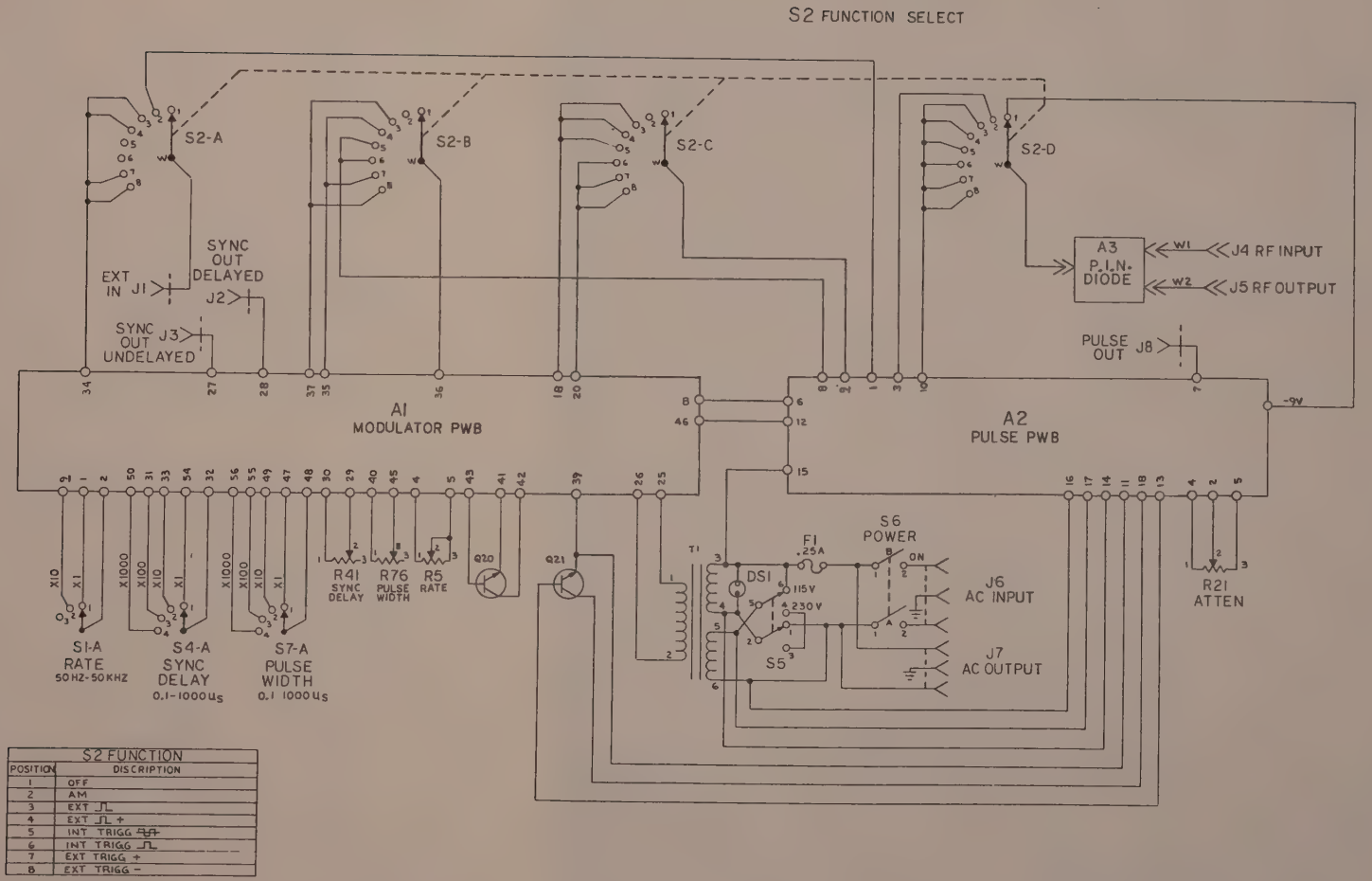
Item	Inspect For	Inspection Interval
Case and Panel	Dirt or corrosion; dents, cracks, scratches, or other physical damage; loose or missing hardware.	Monthly
Switches and Controls	Loose or missing knobs; defective switch action; loose mounting; bent, broken or loose terminals; proper detent or snap action; smooth control rotation from stop to stop; damaged, cracked.	Weekly
Connectors	Bent, broken, or corroded pins; damaged threads; cracked shell; loose or missing hardware.	Monthly
Panel lamps	Cracked or broken lens; missing or defective lamps; loose or missing hardware; bent, broken, or corroded terminals.	Weekly
Wiring	Frayed, broken, or abraided insulation; loose connections; broken wires.	Monthly
Electrical parts	Loose connections or mounting; evidence of overheating such as being cracked, broken, blistered or charred.	Monthly
Cables	Frayed, broken, kinked, or abraided insulation; loose or missing clamps; broken wires; damaged connectors.	Weekly
Fuses	Cracked, damaged, or corroded fuseholders and fuses; correct current rating of fuses; fuseholders securely mounted.	Monthly

SECTION V

SCHEMATIC DIAGRAMS

5-1. GENERAL

5-2. This section contains the schematic diagrams for Model 1020X



S2 FUNCTION	
POSITION	DISCRIPTION
1	OFF
2	AM
3	EXT ⊓
4	EXT ⊓ +
5	INT TRIGG ⊓⊓
6	INT TRIGG ⊓
7	EXT TRIGG +
8	EXT TRIGG −

Figure 5-1. Model 1020X Modulator, Schematic Diagram

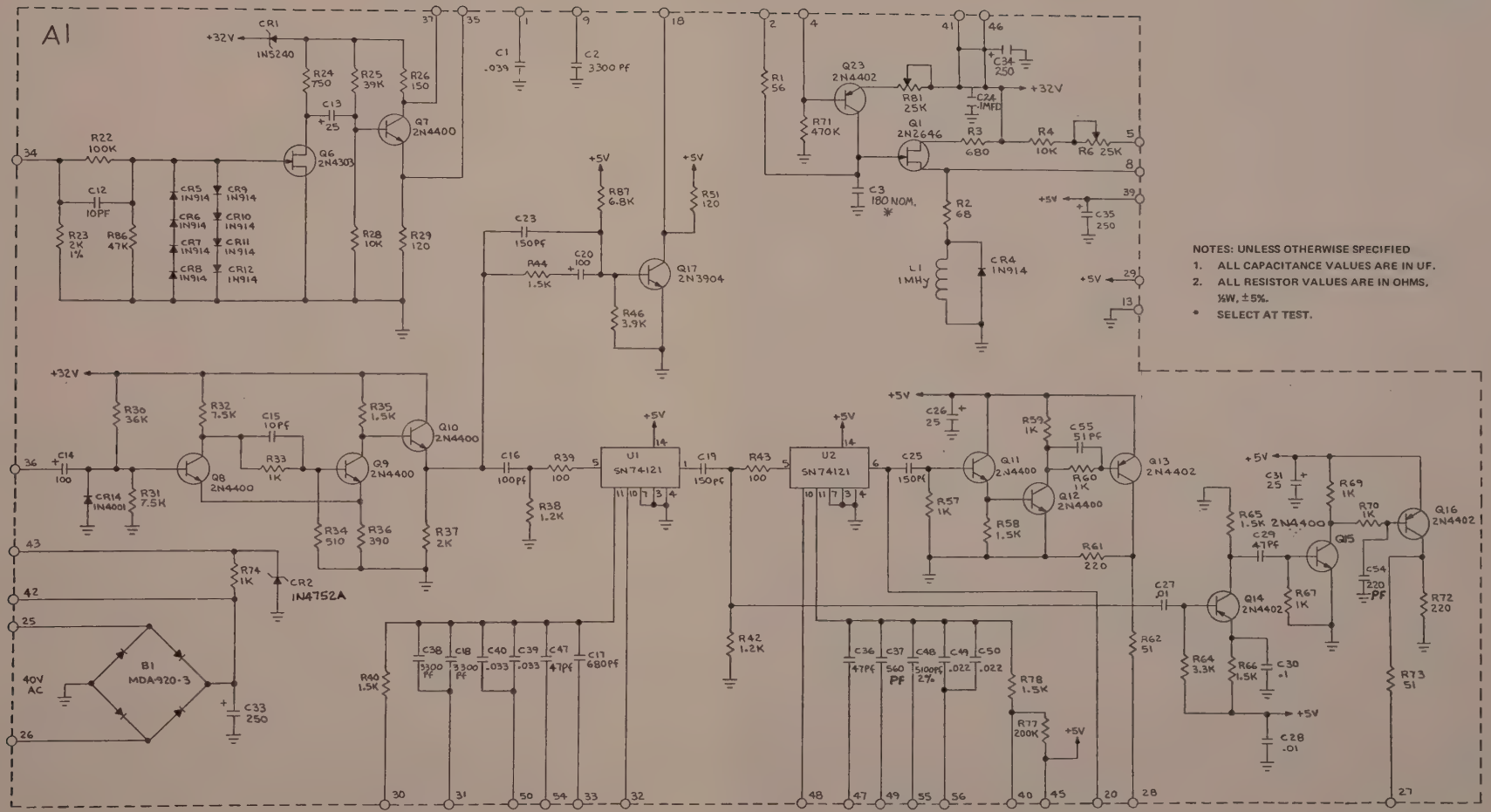


Figure 5-2. Modulator Board Assembly A1, Schematic Diagram

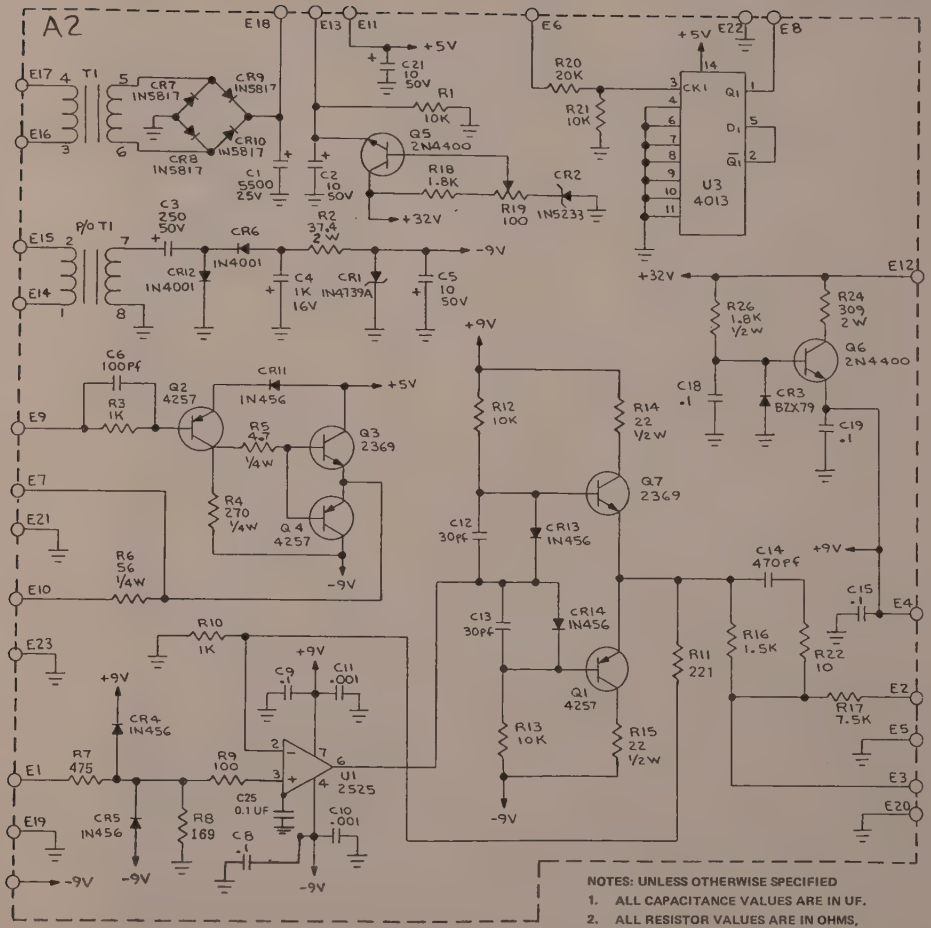


Figure 5-3. Pulse AM Driver Board Assembly A2, Schematic Diagram

SECTION VI

PARTS LIST

6-1. INTRODUCTION

6-2. This parts list provides an alpha-numerical listing in reference symbol sequence of the replaceable electrical, certain electro-mechanical, and mechanical parts of the unit.

6-3. ORDERING INFORMATION. Orders for parts should contain the following information:

a. Equipment name and model number.
b. Serial number
c. Reference symbol of part, if applicable.
d. Manufacturer's part number and code.

6-4. HOW TO USE THE PARTS LIST

6-5. An explanation of the structure of the parts list, table 6-2, and the meaning of the entries in the five columns are given in the following paragraphs. (See figure 6-1.)

6-6. REFERENCE SYMBOL COLUMN. The reference symbol column (1, figure 6-1) contains the reference symbol number assigned to each part, which also identifies the part on the schematic diagram or illustration. The listing is in alpha-numerical order.

6-7. DESCRIPTION COLUMN. The description column (2) contains a brief description of each part.

6-8. MANUFACTURER'S PART NUMBER COLUMN. The manufacturer's part number column (3) contains the part number assigned by the manufacturer of the part.

6-9. MANUFACTURER'S CODE COLUMN. The manufacturer's code column (4) contains a five digit code identifying the manufacturer of the part. Table 6-1 contains a listing of the five digit codes and the manufacturer's names and addresses.

6-10. QUANTITY COLUMN. The quantity column (5) indicates the quantity of each part contained in the respective assembly or subassembly of the instrument.

1 2 3 4 5

TABLE 6-2. PARTS LIST

REF SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR'S CODE	QTY
1A1	HARMONIC GENERATOR	B169999	82199	1
1A2R6	RESISTOR,FIXED,COMPOSITION,1K,5%,½W	RC20GF102J	81349	2
1A2R7	SAME AS 1A2R6			

Figure 6-1. Parts List Example

TABLE 6-1. LIST OF MANUFACTURERS

Code	Name and Address	Code	Name and Address
00779	AMP, Inc. Harrisburgh, PA 17105	34371	Harris Corp. Harris Semiconductor Group Melbourne, FL 32901
01121	Allen-Bradley Milwaukee, WI 53204	37942	Mallory Capacitor Corp. Indianapolis, IN 46206
04713	Motorola Semiconductor Division Phoenix, AZ 85008	56289	Sprague Electronics Corp. N. Adams, MA 01247
09353	C & K Components, Inc. Newton, MA 02158	71590	Centralab Inc. North American Philips Corp. Ft. Dodge, IA 50501
11237	CTS Electronics Pasa Robles, CA93446	75915	Tracor Littelfuse Corp. Des Plaines, IL 60016
13715	Fairchild Camera and Instrument Corp. San Rafael, CA 94902	81349	Military Specifications
14655	Cornell-Dubilier Electronics Newark, NJ 07105	82199	Rohde & Schwarz Inc. Lanham, MD 20706
23480	Electronic Hardware Jamaica, NY 11432	83330	Kulka Smith Inc. Manasquan, NJ 08736
25088	Siemens America, Inc. New York, NY 10001	91637	Dale Electronics Inc. Columbus, NE 68601
25706	Daburg Electronics Bronx, NY 10458		

TABLE 6-2. PARTS LIST

REF SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR'S CODE	QTY
	Modulator (See Fig. 6-2)	**1020X**	**82199**	**1**
A1	Modulator Board Assembly	165831-2	82199	1
A2	Pulse AMDriver Board Assembly	166404-2	82199	1
A3	Pin Modulator	166421	82199	1
DS1	Indicator, Light	710147	82199	1
F1	Fuse, Cartridge, ¼ Amp	312.250	75915	1
J1	Connector, Receptacle	UG625B/U	81349	4
J2	Same As J1			
J3	Same As J1			
J6	Connector, Receptacle	166851	82199	1
J7	Connector, Receptacle	709781	82199	1
J8	Same As J1			
Q20	Transistor	40312	04713	2
Q21	Same As Q20			
R5	Resistor, Variable, 250K	70J1N048P254U	01121	1
R21	Resistor, Variable, 2.5K	162202-54	82199	1
R41	Resistor, Variable, 25K	70J1N048P253U	01121	1
R76	Resistor, Variable, 50K	70J1N048P503U	01121	1
S1	Switch, Rotary	165995-1	82199	1
S2	Switch, Rotary	166411	82199	1
S4	Switch, Rotary	165995-2	82199	2
S5	Switch, Slide	709936	82199	1
S6	Switch, Toggle	7210SYZQ	09353	1
S7	Same As S4			
T1	Transformer, Power	165928	82199	1
TB1	Terminal Strip	15-83A	25706	1
W1	Cable Assembly	166418-2	82199	1
W2	Cable Assembly	166418-3	82199	1
W3	Cable Assembly	166409	82199	1
XF1	Fuseholder	161897	82199	1
	Knob	713390	82199	3
	Knob	713406	82199	1
	Knob	5CC1B2	23480	1
	Foot, Rubber	2181	83330	4

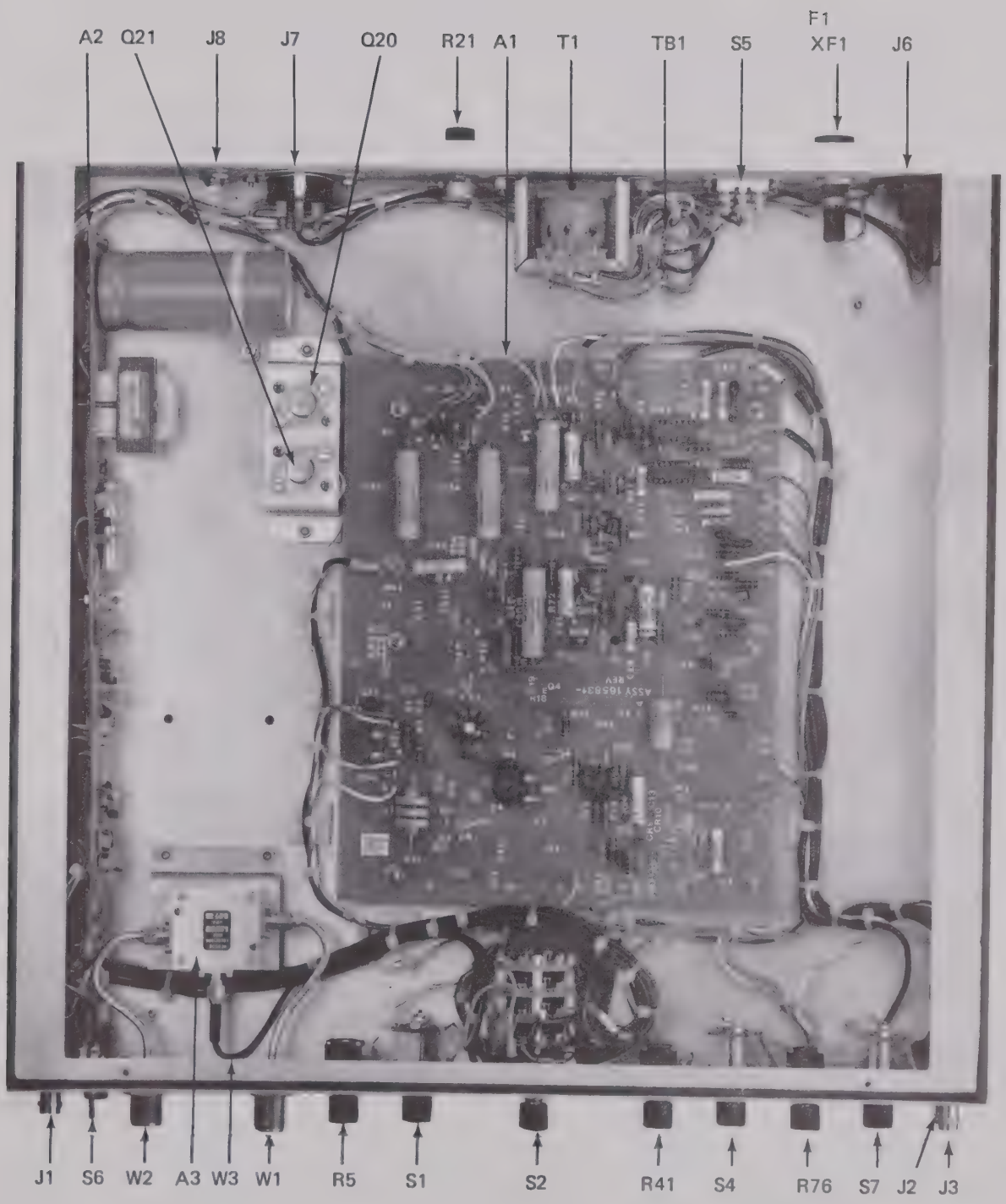


Figure 6-2. Model 1020X Modulator, Top View, Cover Removed

Section VI
Parts List

TABLE 6-2. PARTS LIST

REF SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR'S CODE	QTY
A1	**Modulator Board Assembly (See Fig. 6-3)**	**165831-2**	**82199**	**1**
A1B1	Rectifier, Bridge	MDA920A3	04713	1
A1C1	Capacitor, Fixed, Mylar, 0.039 UF, 100 WVDC	WMF1S39	14655	1
A1C2	Capacitor, Fixed, Mylar, 0.0033 UF	WMF1D33	14655	3
A1C3	Capacitor, Fixed, Mica, 180 PF	CM04FD181J03	81349	1
A1C12	Capacitor, Fixed, Mica, 10 PF, 100 WVDC	CM04CD100J03	81349	1
A1C13	Capacitor, Fixed, Electrolytic, 25 UF, 50 WVDC	TE1305.5	56289	3
A1C14	Capacitor, Fixed, Electrolytic, 100 UF, 100 WVDC	TE1310	56289	2
A1C15	Capacitor, Fixed, Ceramic, 10 PF, 100 WVDC	DD100	71590	1
A1C16	Capacitor, Fixed, Mica, 100 PF	CM15E101J	81349	1
A1C17	Capacitor, Fixed, Mica, 680 PF, 500 WVDC	CM06FD681J03	81349	1
A1C18	Same As A1C2			
A1C19	Capacitor, Fixed, Mica, 150 PF, 300 WVDC	CM15E151J	81349	3
A1C20	Same As A1C14			
A1C23	Same As A1C19			
A1C24	Capacitor, Fixed, Mylar, 0.1 UF, 100 WVDC	WMF1P1	14655	2
A1C25	Same As A1C19			
A1C26	Same As A1C13			
A1C27	Capacitor, Fixed, Mylar, 0.01 UF, 100 WVDC	WMF1S1	14655	2
A1C28	Same As A1C27			
A1C29	Capacitor, Fixed, Mica, 47 PF, 300 WVDC	CM15E470J	81349	1
A1C30	Same As A1C24			
A1C31	Same As A1C13			
A1C33	Capacitor, Fixed, Electrolytic, 250 UF, 50 WVDC	TVA1312	56289	2
A1C34	Same As A1C34			
A1C35	Capacitor, Fixed, Electrolytic, 250 UF, 50 WVDC	TVA1102	56289	1
A1C36	Capacitor, Fixed, Mica, 47 PF, 500 WVDC	CM04ED470J03	81349	2
A1C37	Capacitor, Fixed, Mica, 560 PF, 500 WVDC	CM06FD561J03	81349	1
A1C38	Same As A1C2			
A1C39	Capacitor, Fixed, Mylar, 0.033 UF, 100 WVDC	WMF1S33	14655	2
A1C40	Same As A1C39			
A1C48	Capacitor, Fixed, Mica, 5100 PF, 500 WVDC	CM07FD512G03	81349	1
A1C49	Capacitor, Fixed, Mylar, 0.022 UF, 100 WVDC	WMF1S22-3	14655	2
A1C50	Same As A1C49			
A1C54	Capacitor, Fixed, Mica, 220 PF, 500 WVDC	CM04FD221J03	81349	1
A1C55	Capacitor, Fixed, Mica, 51 PF, 500 WVDC	CM04ED510J03	81349	1
A1CR1	Semiconductor Device, Diode	1N5240	81349	1
A1CR2	Semiconductor Device, Diode	1N4752A	81349	1
A1CR5	Semiconductor Device, Diode	1N914	81349	9
A1CR6	Same As A1CR5			
A1CR7	Same As A1CR5			
A1CR8	Same As A1CR5			
A1CR9	Same As A1CR5			
A1CR10	Same As A1CR5			
A1CR11	Same As A1CR5			
A1CR12	Same As A1CR5			
A1CR14	Semiconductor Device, Diode	1N4001	81349	1
A1L1	Coil, RF	713765	82199	1
A1Q1	Transistor	2N2646	81349	1
A1Q6	Transistor	2N4303	81349	1
A1Q7	Transistor	2N4400	81349	7
A1Q8	Same As A1Q7			

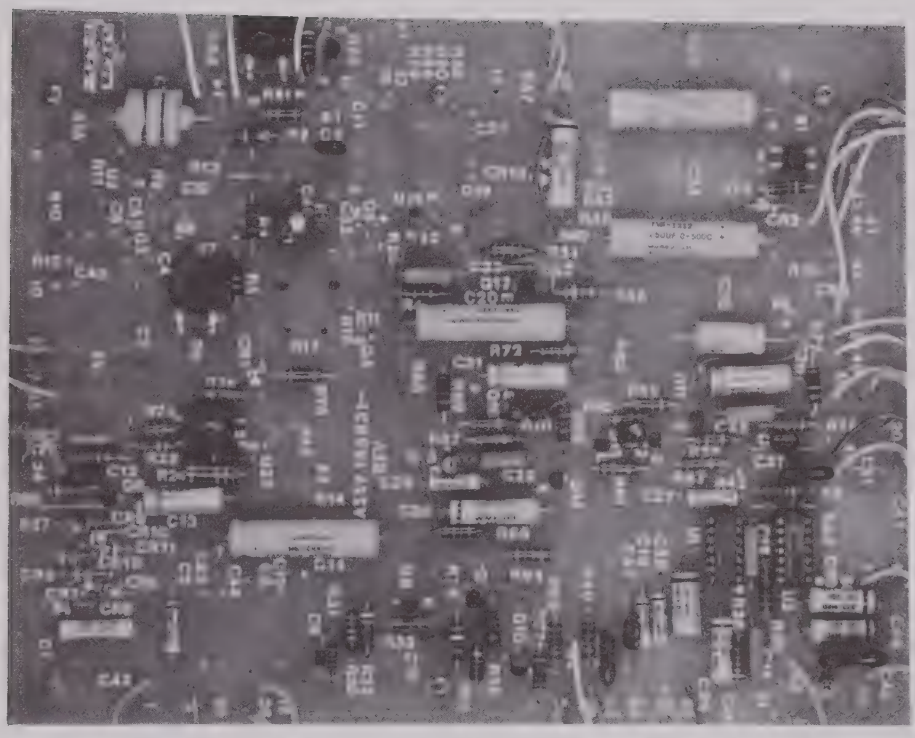


Figure 6-3. Modulator Board Assembly

TABLE 6-2. PARTS LIST

REF SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR'S CODE	QTY
A1Q9	Same As A1Q7			
A1Q10	Same As A1Q7			
A1Q11	Same As A1Q7			
A1Q12	Same As A1Q7			
A1Q13	Transistor	2N4402	81349	4
A1Q14	Same As A1Q13			
A1Q15	Same As A1Q7			
A1Q16	Same As A1Q13			
A1Q17	Transistor	2N3904	81349	1
A1Q23	Same As A1Q13			
A1R1	Resistor, Fixed, Composition, 56 Ohms, 5%, ½W	RC20GF560J	81349	1
A1R2	Resistor, Fixed, Composition, 68 Ohms, 5%, ½W	RC20GF680J	81349	1
A1R3	Resistor, Fixed, Composition, 680 Ohms, 5%, ½W	RC20GF681J	81349	1
A1R4	Resistor, Fixed, Composition, 10K, 5%, ½W	RC20GF103J	81349	2
A1R6	Resistor, Variable, 25K	U201R253B	11237	2
A1R22	Resistor, Fixed, Composition, 100K, 5%, ½W	RC20GF104J	81349	1
A1R23	Resistor, Fixed, Film, 2K, 1%, ¼W	RN60D2001F	81349	1
A1R24	Resistor, Fixed, Composition, 750 Ohms, 5%, ½W	RC20GF751J	81349	1
A1R25	Resistor, Fixed, Composition, 39K, 5%, ½W	RC20GF393J	81349	1
A1R26	Resistor, Fixed, Composition, 150 Ohms, 5%, ½W	RC20GF151J	81349	2
A1R28	Same As A1R4			
A1R29	Resistor, Fixed, Composition, 120 Ohms, 5%, ½W	RC20GF121J	81349	2
A1R30	Resistor, Fixed, Composition, 36K, 5%, ½W	RC20GF363J	81349	1
A1R31	Resistor, Fixed, Composition, 7.5K, 5%, ½W	RC20GF752J	81349	2
A1R32	Same As A1R31			
A1R33	Resistor, Fixed, Composition, 1K, 5%, ½W	RC20GF102J	81349	8
A1R34	Resistor, Fixed, Composition, 510 Ohms, 5%, ½W	RC20GF511J	81349	1
A1R35	Resistor, Fixed, Composition, 1.5K, 5%, ½W	RC20GF152J	81349	8
A1R36	Resistor, Fixed, Composition, 390 Ohms, 5%, ½W	RC20GF391J	81349	1
A1R37	Resistor, Fixed, Composition, 2K, 5%, ½W	RC20GF202J	81349	2
A1R38	Resistor, Fixed, Composition, 1.2K, 5%, ½W	RC20GF122J	81349	2
A1R39	Resistor, Fixed, Composition, 100 Ohms, 5%, ½W	RC20GF101J	81349	2
A1R40	Same As A1R35			
A1R42	Same As A1R38			
A1R43	Same As A1R39			
A1R44	Same As A1R35			
A1R46	Resistor, Fixed, Composition, 3.9K, 5%, ½W	RC20GF392J	81349	1
A1R51	Same As A1R29			
A1R57	Same As A1R33			
A1R58	Same As A1R35			
A1R59	Same As A1R33			
A1R60	Same As A1R33			
A1R61	Resistor, Fixed, Composition, 220 Ohms, 5%, ½W	RC20GF221J	81349	2
A1R62	Resistor, Fixed, Composition, 51 Ohms, 5%, ½W	RC20GF510J	81349	2
A1R64	Resistor, Fixed, Composition, 3.3K, 5%, ½W	RC20GF332J	81349	1
A1R65	Same As A1R35			
A1R66	Same As A1R35			
A1R67	Same As A1R33			
A1R69	Same As A1R33			
A1R70	Same As A1R33			

TABLE 6-2. PARTS LIST

REF SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR'S CODE	QTY
A1R71	Resistor, Fixed, Composition, 470K, 5%, ½W	RC20GF474J	81349	1
A1R72	Same As A1R61			
A1R73	Same As A1R62			
A1R74	Same As A1R33			
A1R77	Resistor, Fixed, Composition, 200K, 5%, ½W	RC20GF204J	81349	1
A1R78	Same As A1R35			
A1R81	Same As A1R6			
A1R86	Resistor, Fixed, Composition, 47K, 5%, ½W	RC20GF473J	81349	1
A1R87	Resistor, Fixed, Composition, 6.8K, 5%, ¼W	RC07GF682J	81349	1
A1U1	Integrated Circuit	74121PC	13715	2
A1U2	Same As A1U1			
A1XU1	Socket, IC	640357-1	00779	2
A1XU2	Same As A1XU1			

TABLE 6-2. PARTS LIST

REF SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR'S CODE	QTY
A2	**Pulse AM Driver Board Assembly**	166404-2	82199	1
A2C1	Capacitor, Fixed, Electrolytic, 5500 UF, 25 WVDC	36D553G025DD2A	56289	1
A2C2	Capacitor, Fixed, Electrolytic, 10 UF, 50 WVDC	196D106X0050PE3	56289	3
A2C3	Capacitor, Fixed, Electrolytic, 250 UF, 50 WVDC	TVA1312	56289	1
A2C4	Capacitor, Fixed, Electrolytic, 1000 UF, 16 WVDC	TC1501A	37942	1
A2C5	Same As A2C2			
A2C6	Capacitor, Fixed, Mica, 100 PF	CM04FD101J03	81349	1
A2C8	Capacitor, Fixed, Ceramic, 0.1 UF, 50 WVDC	CK05BX104K	81349	5
A2C9	Same as A2C8			
A2C10	Capacitor, Fixed, Ceramic, 0.001 UF, 50 WVDC	CK05BX102K	81349	2
A2C11	Same As A2C10			
A2C12	Capacitor, Fixed, Mica, 30 PF	CM04ED300J03	81349	2
A2C13	Same As A2C12			
A2C14	Capacitor, Fixed, Mica, 470 PF	CM04FD471J03	81349	1
A2C15	Same As A2C8			
A2C18	Same As A2C8			
A2C19	Same As A2C8			
A2C21	Same As A2C2			
A2C25	Capacitor, Fixed, Ceramic, 0.1 UF, 100 WVDC	900006-62	82199	1
A2CR1	Semiconductor Device, Diode	1N4739A	81349	1
A2CR2	Semiconductor Device, Diode	1N5233B	81349	1
A2CR3	Semiconductor Device, Diode	BZX79/C10	25088	1
A2CR4	Semiconductor Device, Diode	1N456	81349	5
A2CR5	Same as A2CR4			
A2CR6	Semiconductor Device, Diode	1N4001	81349	2
A2CR7	Semiconductor Device, Diode	1N5817	81349	4
A2CR8	Same As A2CR7			
A2CR9	Same As A2CR7			
A2CR10	Same As A2CR7			
A2CR11	Same As A2CR4			
A2CR12	Same As A2CR6			
A2CR13	Same As A2CR4			
A2CR14	Same As A2CR4			
A2Q1	Transistor	2N4257	81349	3
A2Q2	Same As A2Q1			
A2Q3	Transistor	2N2369	81349	2
A2Q4	Same As A2Q1			
A2Q5	Transistor	2N4400	81349	2
A2Q6	Same As A2Q5			
A2Q7	Same As A2Q3			
A2R1	Resistor, Fixed, Film, 10K, 1%, 1/8W	RN55D1002F	81349	4
A2R2	Resistor, Fixed, Wire Wound, 37.4 Ohms, 1%, 2W	G-3-80,37.4Ω,2W,1%	91637	1
A2R3	Resistor, Fixed, Film, 1K, 1%, 1/8W	RN55D1001F	81349	2
A2R4	Resistor, Fixed, Composition, 270 Ohms, 5%, ¼W	RC07GF271J	81349	1
A2R5	Resistor, Fixed, Composition, 4.7 Ohms, 5%, ¼W	RC07GF4R7J	81349	1
A2R6	Resistor, Fixed, Composition, 56 Ohms, 5%, ¼W	RC07GF560J	81349	1
A2R7	Resistor, Fixed, Film, 475 Ohms, 1%, 1/8W	RN55D4750F	81349	1
A2R8	Resistor, Fixed, Film, 169 Ohms, 1%, 1/8W	RN55D1690F	81349	1
A2R9	Resistor, Fixed, Film, 100 Ohms, 1%, 1/8W	RN55D1000F	81349	1
A2R10	Same As A2R3			
A2R11	Resistor, Fixed, Film, 221 Ohms, 1%, 1/8W	RN55D2210F	81349	1

TABLE 6-2. PARTS LIST

REF SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR'S CODE	QTY
A2R12	Same As A2R1			
A2R13	Same As A2R1			
A2R14	Resistor, Fixed, Composition, 22 Ohms, 5%, ½W	RC20GF220J	81349	2
A2R15	Same As A2R14			
A2R16	Resistor, Fixed, Film, 1.5K, 1%, 1/8W	RN55D1501F	81349	1
A2R17	Resistor, Fixed, Film, 7.5K, 1%, 1/8W	RN55D7501F	81349	1
A2R18	Resistor, Fixed, Film, 1.8K, 1%, 1/8W	RN55D1801F	81349	1
A2R19	Resistor, Variable, 100 Ohms	RJ24FX101F	81349	1
A2R20	Resistor, Fixed, Film, 20K, 1%, 1/8W	RN55D2002F	81349	1
A2R21	Same As A2R1			
A2R22	Resistor, Fixed, Film, 10 Ohms, 1%, 1/8W	RN55D10R0F	81349	1
A2R24	Resistor, Fixed, Wire Wound, 309 Ohms, 1%, 2W	G-3-80, 309Ω,1%,2W	91637	1
A2R26	Resistor, Fixed, Composition, 1.8K, 5%, ½W	RC20GF182J	81349	1
A2T1	Transformer	166419	82199	1
A2U1	Integrated Circuit	HA2525-5	34371	1
A2U3	Integrated Circuit	920063-01	82199	1

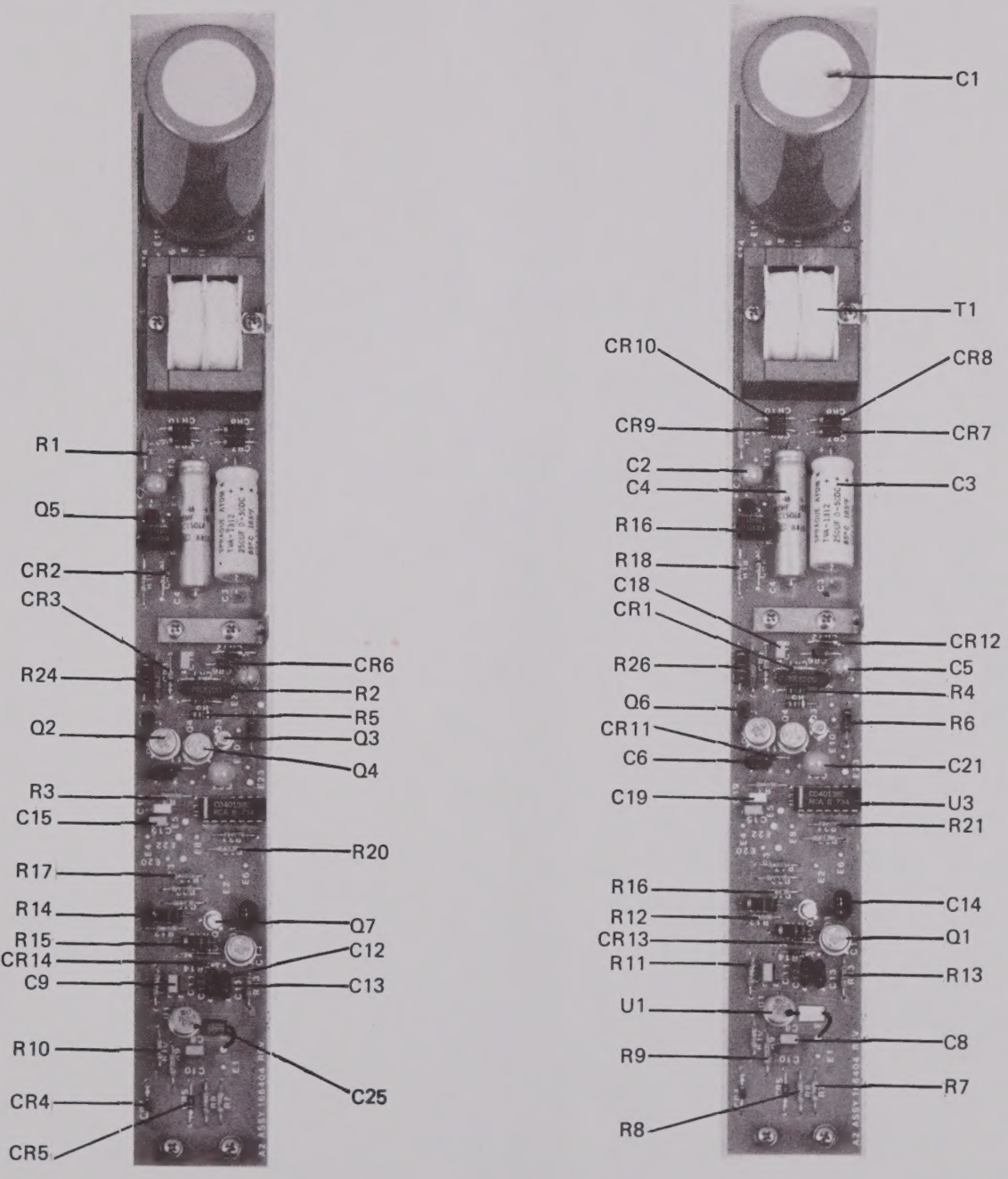


Figure 6-4. Pulse AM Driver Board Assembly

MP MASTER
MA20107